AD-A099 157 DEFENSE COMMUNICATIONS ENGINEERING CENTER RESTON VA F/G 17/2
IMPACT OF THE COMMON USER NETWORK RATE STRUCTURE.(U)
AUG 80 W G HARTUNG
UNCLASSIFIED DCEC-TN-8-80 NL

1 of 1
AD
A099 157

END
DATE
FILMED
6 81
DTIC

(21) LEVEL II

TN 8-80

DEFENSE COMMUNICATIONS ENGINEERING CENTER

AD A099157

TECHNICAL NOTE NO. 8-80

IMPACT OF THE COMMON USER NETWORK RATE STRUCTURE

AUGUST 1980

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

UNCLASSIFIED Aug 1980

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER DCEC-TN-8-80	2. GOVT ACCESSION NO. AD-A099 157	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) IMPACT OF THE COMMON USER NETWORK RATE STRUCTURE		5. TYPE OF REPORT & PERIOD COVERED Technical Note
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) W. G. Hartung		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Defense Communications Engineering Center Systems Engineering Division, 1860 Wiehle Avenue Reston, VA 22090		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS N/A
11. CONTROLLING OFFICE NAME AND ADDRESS Same as 9		12. REPORT DATE August 1980
		13. NUMBER OF PAGES 17
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) N/A		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release; Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

N/A

18. SUPPLEMENTARY NOTES

Review relevance 5 years from submission date.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Tariff	Communications Services Industrial Fund
AUTOVON	Special Purpose Networks
AUTODIN	Data Networks
CSIF	Voice Networks

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An analysis is presented of the the cost options to CONUS AUTOVON and AUTODIN subscribers. The impact of the Communications Services Industrial Fund (CSIF) rates on those subscribers is examined and the cost trade-offs determined. It is shown that these are sufficient economic incentives for certain classes of common user network subscribers to use commercial alternatives to AUTOVON and AUTODIN.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

TECHNICAL NOTE NO. 8-80

IMPACT OF THE COMMON USER NETWORK RATE STRUCTURE

AUGUST 1980

Prepared by:

- W. G. Hartung

Approved for Publication:

G. E. LaVEAN
Chief, Systems Engineering Division

FOREWORD

The Defense Communications Engineering Center (DCEC) Technical Notes (TN's) are published to inform interested members of the defense community regarding technical activities of the Center, completed and in progress. They are intended to stimulate thinking and encourage information exchange; but they do not represent an approved position or policy of DCEC, and should not be used as authoritative guidance for related planning and/or future action.

Comments or technical inquiries concerning this document are welcome, and should be directed to:

Director
Defense Communications Engineering Center
1860 Wiehle Avenue
Reston, VA 22090

EXECUTIVE SUMMARY

Common user networks such as AUTOVON and AUTODIN are derived within the CONUS from commercial common carrier offerings. The subscribers to these networks pay a fixed charge as determined from the Communications Services Industrial Fund (CSIF) rate schedule. This charge, in many cases, is substantially different from available tariffed services. In addition, for some users, the CSIF charge does not reflect the government's cost to furnish the service. As a result, it is in many instances less costly to the subscriber to use a commercial service. Such local optimizations tend to increase the total cost to the government for such communications. This study examines these trade-offs from the user's point of view and shows that for certain classes of users, the CSIF rate structure forces them to the commercial offerings. These include low data rate subscribers to AUTODIN and in general subscribers either within a limited geographic area or having a small community of interest. It is suggested that the CSIF rate schedules be reflective of commercial tariff alternatives and consistent in rate form. This would preclude the optimization of the subscriber's cost at the expense of increasing the government's total communications cost.

TABLE OF CONTENTS

		Page
	EXECUTIVE SUMMARY	iii
I.	INTRODUCTION	1
II.	CURRENT CHARGES	2
III.	COST EFFECTIVENESS OF COMMON USER NETWORKS	6
	1. Methodology	6
	2. Voice Network	7
	3. Data Networks	8
	4. Overall Impact	8
IV.	CONCLUSIONS	13

LIST OF ILLUSTRATIONS

Figure	Title	Page
1	SPN SIZE AS A FUNCTION OF PRECEDENCE LEVEL FOR TELPAK TARIFF	8
2	SPN SIZE AS A FUNCTION OF PRECEDENCE LEVEL FOR MPL TARIFF	9
3	SIZE OF SPN COMMUNITY AS A FUNCTION OF TARIFF	10
4	SPN SIZE AS A FUNCTION OF DATA RATE FOR DDS TARIFF	12

LIST OF TABLES

Table	Title	Page
I	1981 MONTHLY CSIF PLANNING RATES	3
II	CHARGES FOR COMMERCIAL VOICE SERVICE	4
III	CHARGES FOR DATAPHONE DIGITAL SERVICE	5

I. INTRODUCTION

Common user networks are a major element of the Defense Communications System (DCS). In CONUS, the DCS comprises three major common user networks - AUTOVON, AUTODIN and AUTOSEVOCOM - and is derived primarily from tariffed offerings. Each network provides CONUS and worldwide communications. Network charges are determined on the basis of services furnished and are intended to recoup, in total, the cost of the network. Since they do not reflect the commercial tariff, these charges can be significantly different when compared with commercial alternatives. This industrial funding structure works both to the user's advantage in some cases and disadvantage in others. The service categories, rather than being defined by usage and distance as in the commercial tariffs, are defined by broad geographic areas such as CONUS, Europe and Pacific and by level of precedence for the AUTOVON service. For a given service, the charge is a flat monthly rate (exclusive of access cost). Subscribers not requiring the whole spectrum of service pay the same as those utilizing all of the service's features. This places some subscribers at a cost disadvantage. Depending upon the relationship between the industrial funding structure and the commercial tariff structure, significant cost disparities can result for certain classes of users.

It is instructive for the DCA to examine the industrial funding charges and structure in light of what options are available to the CONUS DCS subscriber. This report examines the cost issues of such networks by comparing the Communications Services Industrial Fund (CSIF) rates for the CONUS AUTOVON and AUTODIN common user networks with available tariffed services.

The analysis is concerned only with communications within CONUS. Transoceanic communications are very costly and the benefits of pooling transoceanic telecommunications resources, especially transatlantic, are obvious. Because much of the DCS abroad is government-owned and competitive services are generally nonexistent, the overseas segments of the DCS were excluded.

II. CURRENT CHARGES

The CSIF charges used in this study are the DCA FY 1981 planning costs for CONUS AUTOVON service and high speed AUTODIN II monthly planning rates. These rates are summarized in Table I. The charges shown in this table exclude the cost to access the AUTOVON or AUTODIN switching center and the costs for end instruments, terminals and installation. These CSIF rates do not reflect the additional costs which may be incurred when the TELPAK service disappears.

Tariffed commercial offerings are available from a number of vendors. This study limited itself to the three major offerings of AT&T: TELPAK, MPL and DDS. TELPAK was initiated in 1961 to provide commercial users with bulk discounts. Recent Federal Communication Commission (FCC) rulings regarding TELPAK led AT&T to attempt to withdraw this offering. At the initiation of TELPAK users, AT&T, through a court decision, was forced to continue the offering to users of record. The proposed alternative as well as the alternative for new private line subscribers is the Multi-Schedule Private Line (MPL) service. Both TELPAK and MPL provide voice grade leased lines between two points. The costs for voice grade service is shown in Table II. For data, AT&T offers the Dataphone Digital Service (DDS) which provides private digital circuits for full-duplex synchronous transmission at speeds of 2.4, 4.8, 9.6 and 56 kb/s. The AT&T charges are summarized in Table III.

TABLE I. 1981 MONTHLY CSIF PLANNING RATES

CONUS AUTOVON

Precedence Level	Charge
Flash	$1400/mo
Immediate	1050/mo
Priority	700/mo
Routine	350/mo

AUTODIN II

Data Rate	Charge
56 kb/s	$5400/mo
9.6 kb/s	4050/mo
4.8 kb/s	3375/mo
2.4 kb/s	2700/mo

NOTE: These rates assume the availability of the TELPAK service.

TABLE II. CHARGES FOR COMMERCIAL VOICE SERVICE

1. TELPAK: $86.60 + $0.56/mile

2. MPL (Schedule 1)

   a. Mileage Charge

Circuit Length (Miles)	Rate
0-15	$1.89/mile
16-25	28.35 + $1.58/mile $\geq$ 15
26-100	44.15 + $1.18/mile $\geq$ 25
101-1000	132.65 + $0.69/mile $\geq$ 100

   b. Fixed Charge - $51.72

   c. Station Terminal Charge (per terminal) - $26.30

Total MPL cost is the sum of the charges for a, b and c above. Thus, a 20 mile circuit would cost 28.35 + 5 x 1.58 + 51.72 + 2 x 26.30, or $140.57/month.

NOTE: Costs are per month and reflect point-to-point private line voice grade circuits.

TABLE II. CHARGES FOR DATAPHONE DIGITAL SERVICE

Mileage Charge

Item	2.4 - 9.6 kb/s	56 kb/s
Basic Charge	$49.20	$246.00
First 15 Miles	1.80	9.00
Next 10 Miles	1.50	7.50
Next 75 Miles	1.12	5.60
Next 500 Miles	0.66	3.30
Each Additional Mile Over 100	0.40	2.00

Service Terminal (per end)	Speed of Service			
	2.4	4.8	9.6	56
Central Office Termination	$25.00	$25.00	$32.33	$125.00
Central Office Data Access Line	$44.10	$119.55	$233.55	$504.40

NOTE: Total cost per month for a point-to-point digital circuit is the sum of the mileage charges, central office termination (at both ends) and central office data access line (at both ends).

III. COST EFFECTIVENESS OF COMMON USER NETWORKS

1. METHODOLOGY

The cost trade-offs are made from the user's point of view. For the purposes of this study, it is assumed that each user can use either AUTOVON and AUTODIN or a commercial alternative and that the choice is governed by the economics. Other considerations are excluded in this study. In order to access AUTOVON or AUTODIN, the user must lease from commercial vendors, usually AT&T, public facilities between his site and the nearest AUTOVON or AUTODIN switching center. These costs vary depending upon the actual distance involved and the location of both the switching center and the user site within the carrier's geographic rate centers. In order to present the cost trade-offs, a nominal charge of $100 per month is assumed. This represents a user site located in the same rate center as the common user switching center.

If only two users require voice service, they could form their own special purpose network (SPN). This would simply be a private line between the two sites. If the sites were 100 miles apart and the TELPAK tariff applied, the charge for the commercial service can be determined from Table II as $142.60 per month. For these two subscribers to communicate using AUTOVON, the cost, at a routine precedence level, is determined from Table I as $350.00 per user. Assuming a $100 access cost, the total cost for these subscribers under the AUTOVON common user network is $900.00. If we were to continue this comparison for additional subscribers, we would find that the total AUTOVON common user charge increases linearly whereas the TELPAK charge increases in proportion to the square of the number of users. If U is the number of users and C the total TELPAK point-to-point charge for a given distance, then the total cost for a fully connected network of U users is as follows:

$$\text{Cost} = U \times (U-1)/2 \times C.$$

Note that C represents a cost for two users.

The cost for U AUTOVON users is simply the product of U and the average cost per subscriber.

We now wish to determine the size (N) of a special purpose network community of users where total commercial cost is less than or equal to the total AUTOVON cost. This size reflects the break point at which one or the other is more cost effective. If A is the AUTOVON charge per subscriber, then we wish to determine the following:

$$U \times (U-1)/2 \times C \quad U \times A.$$

The solution can be generalized in terms of the ratio of AUTOVON common user network cost (per user) to the commercial charge (two users), R. Note that R is mileage dependent. We thus have the following relationship:

$$N = 2 \times R + 1$$

where

N - Size up to which a special purpose network community has a cost advantage.

R - Ratio of common user network cost to commercial charge.

Thus, if the number of users, U, is less than or equal to N, they will have a cost advantage in forming their own private network.

In the example presented, R varies with the distance between users and at 100 miles is (350+100)/142.60 or 3.16. Thus, for a distance of 100 miles, up to seven (2x3+1) users could form a special purpose network using TELPAK and incur a total cost less than that through AUTOVON. Of course, should these users decide to communicate with a larger community, this relationship is no longer valid.

Since private line service is equivalent to a Flash precedence capability, one could recompute the ratio R using the appropriate charge shown in Table I. This would result in a ratio of 10.52, yielding a maximum SPN size of 22.

The maximum size of the special purpose network community is related to the ratio of the common user network cost to the commercial tariff. Aside from measuring the size of the community, this number is indicative of the impact of the CSIF charge on the DCS user.

2. VOICE NETWORKS

Using the procedures outlined above, cost effective SPN sizes have been computed for the TELPAK and MPL (Schedule 1) private line voice grade offerings. The results are presented in Figures 1, 2 and 3. The area above the curves represents the conditions where the AUTOVON network is cost effective. The area below these curves indicates the conditions where it is more cost effective for the subscribers to form their own private network. As is evident in these figures, common user voice networks (AUTOVON) are cost effective for large numbers of subscribers widely separated geographically. While this is no surprise, it should be noted that there is considerable incentive for users to form their own special purpose network.

As indicated in these figures, small groups can effectively provide their own networks. The specific size is, of course, a function of the size and geographic distribution of the total community of interest. Thus, for a limited community of interest where there is high traffic volume, a SPN may be cost effective when combined with say WATS for those infrequent calls outside the community.

The impact of the specific tariff is shown in Figure 3. Here, a Flash precedence is assumed. While the SPN community is impacted by the tariff form, the impact may not be as large as shown if the CSIF rates were adjusted

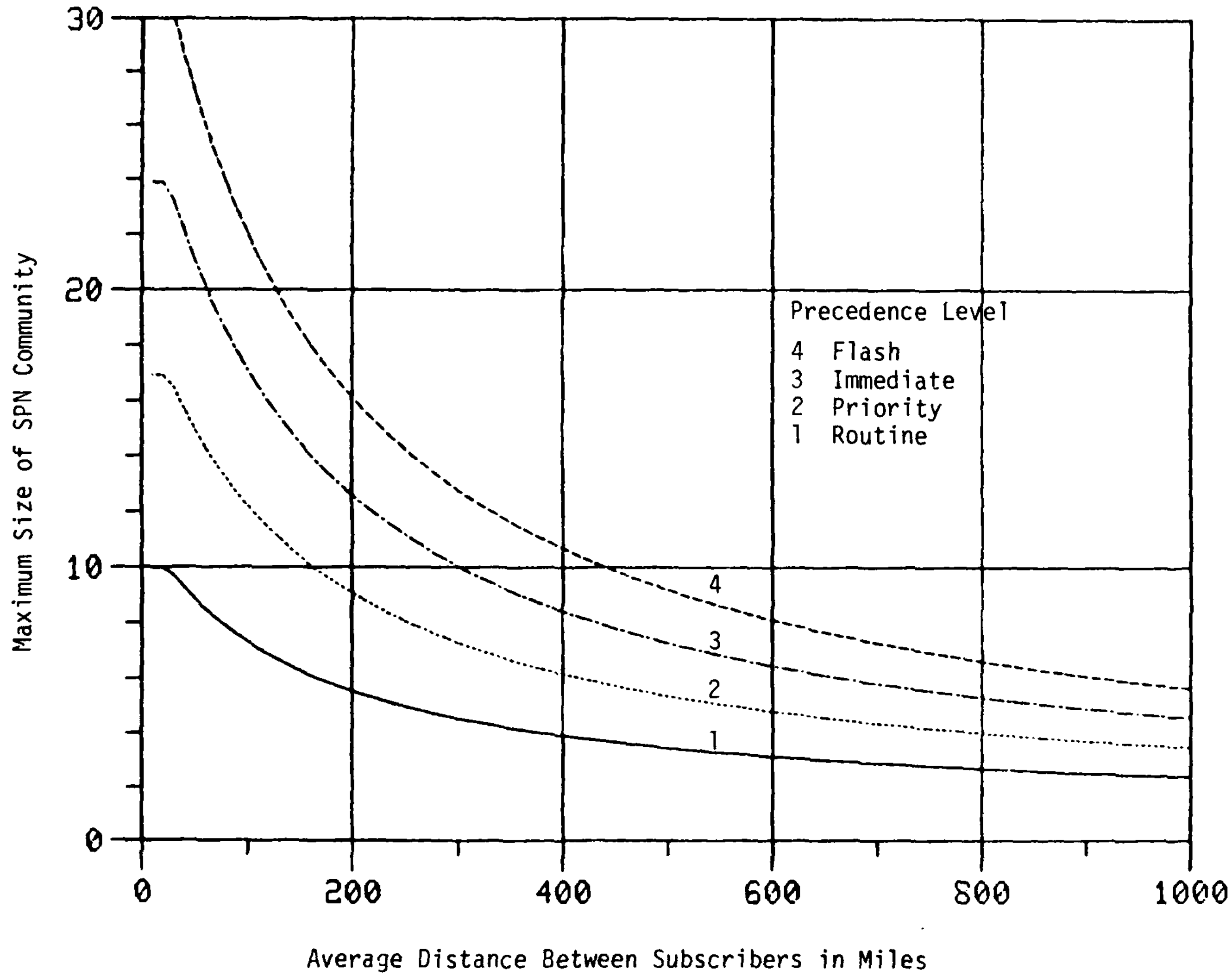

Figure 1. SPN Size as a Function of Precedence Level for TELPAK Tariff

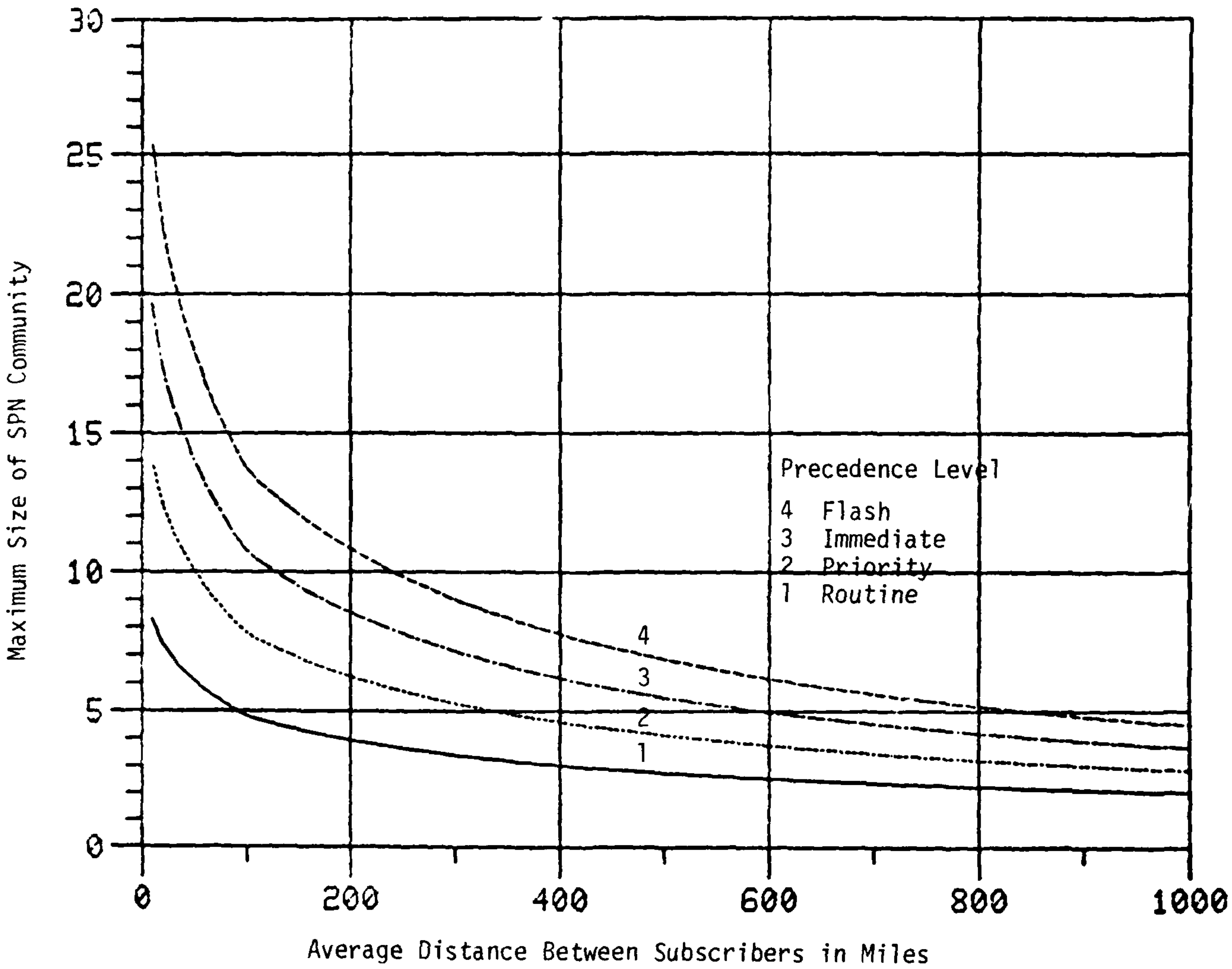

Figure 2. SPN Size as a Function of Precedence Level for MPL Tariff

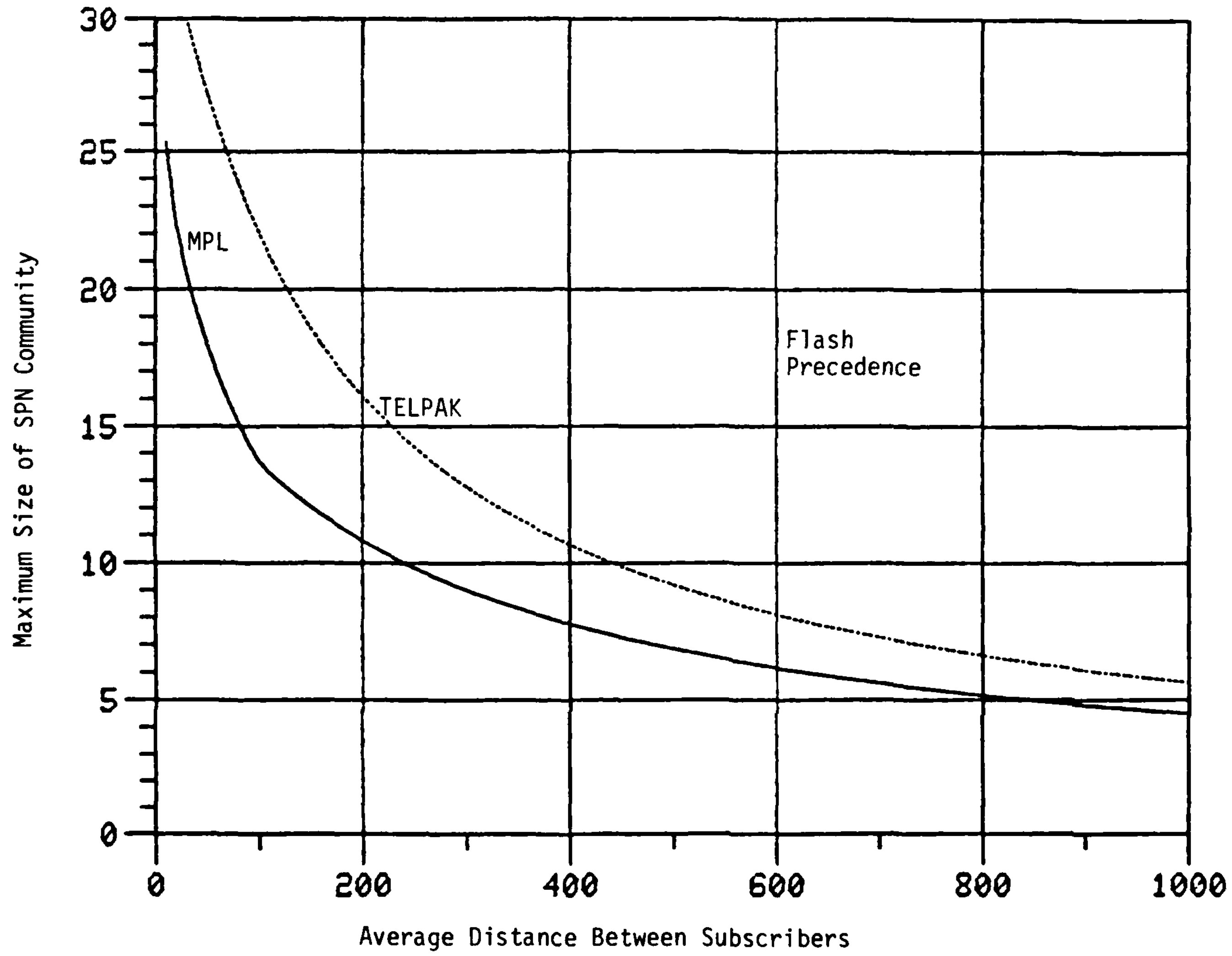

Figure 3. Size of SPN Community as a Function of Tariff

to reflect the TELPAK replacement tariff, which at this writing is unknown. One would expect that the TELPAK curve in Figure 3 would also be representative of the SPN size for an AUTOVON CSIF rate reflecting the TELPAK replacement.

These results by themselves do not indicate when a SPN is more cost effective. Rather, what is significant is the fact that the CSIF rate structure for the common user voice network is not always the least costly alternative. The rate structure favors the subscriber whose requirements necessitate frequent communication with a large community widely separated geographically. The terrestrial commercial offerings favor just the opposite: short distances and a small community of interest.

3. DATA NETWORKS

Comparisons also were made between AUTODIN, the data common user network, and the AT&T commercial offering DDS. The results are shown in Figure 4 for the following data rates: 2.4 kb/s, 4.8 kb/s, 9.6 kb/s and 56 kb/s. The surprising results of this analysis as evident in Figure 4 are that the low data rate users of AUTODIN are charged at a disproportionate rate compared with the DDS tariff. This is shown in the graph by the significant spread between the low data rates and the 56 kb/s rate. At distances in excess of 700 miles, the AUTODIN CSIF rates track commercial rates as shown by the blending of the three curves. At distances less than 400 miles, the low data rate subscriber's charge is disproportionate compared with commercial offerings. If the AUTODIN CSIF charges were to track commercial offerings, all four curves would be within a narrow band.

Thus, for data networks, the user with high speed data transmission requirements has the greater incentive to be in the AUTODIN common user network. Low data rate users have an incentive to form their own special purpose group.

4. OVERALL IMPACT

At first glance, it appears that because the community size is relatively small, we are considering only minor cost impacts. For example, CONUS AUTOVON has in excess of 16,000 subscribers (access lines) and the maximum SPN size shown is less than 30. It thus would appear that, in the AUTOVON example, somewhat less that 0.00002 percent of the population is impacted. This is far from true.

Without subscriber-to-subscriber statistics, it is not possible to determine the size and number of subscriber communities wherein a significant percentage of the traffic is confined. Much communication tends to confine itself within an organizational entity or activity. For example, logistics, comptroller or engineering activities would form natural communities of interest. The number of such communities is quite large, yet the population within each is relatively small. Thus, the SPN sizes of 5 to 30 tend to become large fractions of such communities of interest. Multiply this by the number of such communities and the overall impact becomes large.

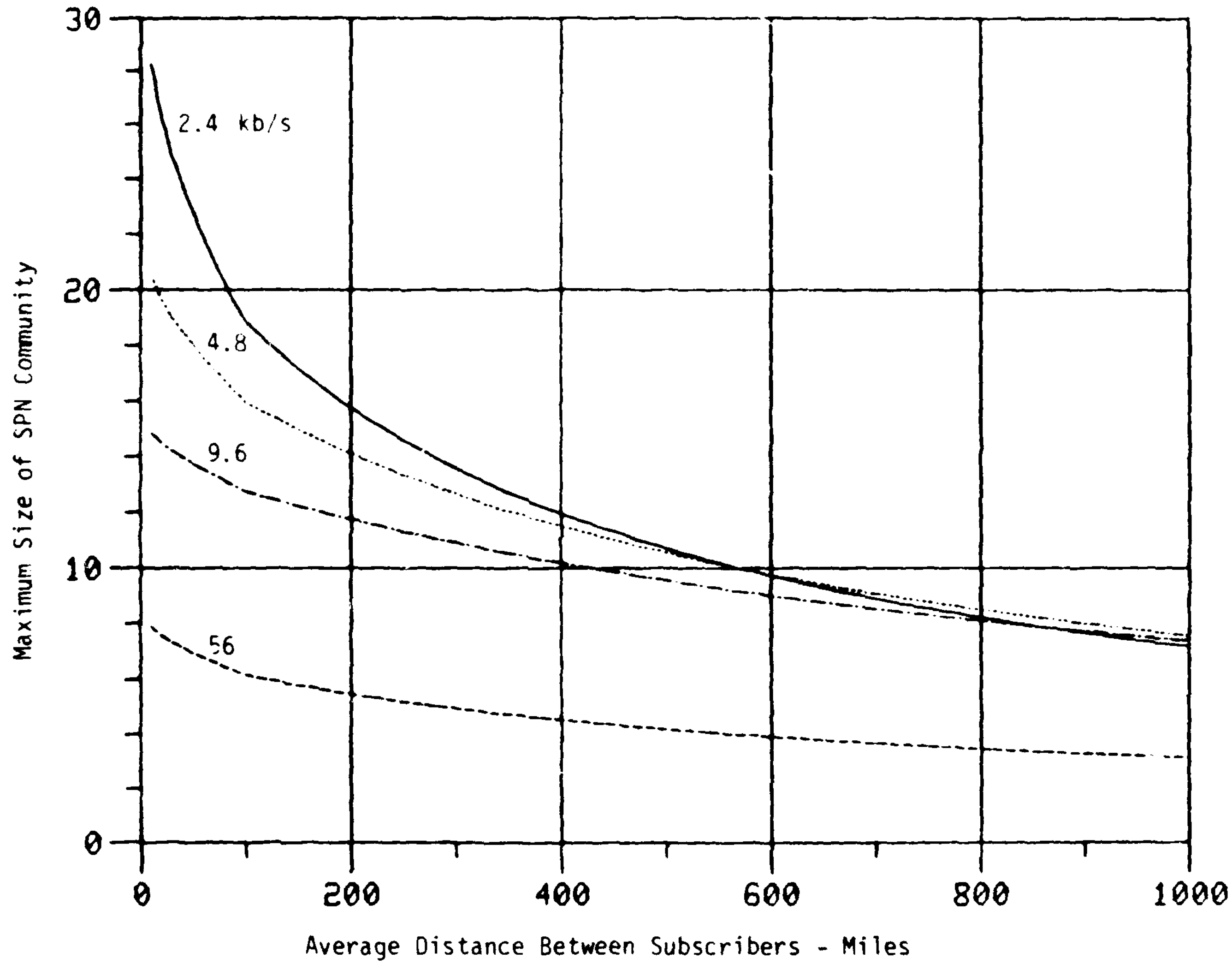

Figure 4. SPN Size as a Function of Data Rate for DDS Tariff

IV. CONCLUSIONS

Common user networks such as AUTOVON and AUTODIN, which are derived from CONUS common carrier offering, are not the least cost alternatives for all classes of users. Depending on how the CSIF rate is structured, certain classes of users, e.g. low data rate subscribers to AUTODIN, will be driven to the commercial offerings.

The CSIF rate structure for CONUS needs to consider the available tariffs in order to provide a financial incentive to the largest spectrum of potential users. It appears that both geographic proximity and community of interest need to be considered in developing a rate. Small community of interest subscribers currently have little incentive to join the DoD common user voice network. Likewise, low data rate subscribers, especially those within a geographically limited community of interest, are offered no economic incentive by the AUTODIN CSIF rate structure. These flat charge rate structures cannot provide financial advantages to all classes of subscribers.

Alternative structures would include a CSIF structure emulating the WATS tariff which considers both geographic proximity and total usage. Another alternative would be to have a structure in the form of Ax+B where x is the airline mileage between subscribers and A and B parameters reflecting the total cost to provide the service. This structure may also be stratified by class of service. Such rates should attract more users and ultimately reduce the total cost to the government. Improved rate structures would enable the minimization of both cost to the subscriber and the total cost to the government.

DISTRIBUTION LIST

R100 - 2
R102/R103/R103R - 1
R102M - 1
R102T - 9 (8 for stock)
R104 - 1
R110 - 1
R123 - 1 (Library)
R124A - 1 (for Archives)

R200 - 1
R300 - 1
R400 - 1
R500 - 1
R700 - 1
R800 - 1
NCS-TS - 1
101A - 1
312 - 1

* R102T - 12 (Unclassified/Unlimited Distribution)

DCA-EUR - 2 (Defense Communications Agency European Area
ATTN: Technical Director
APO New York 09131)

DCA-PAC - 3 (Commander, Defense Communications Agency Pacific Area
Wheeler AFB, HI 96854)

DCA SW PAC - 1 (Commander, DCA-Southwest Pacific Region
APO San Francisco 96274)

DCA NW PAC - 1 (Commander, DCA-Northwest Pacific Region
APO San Francisco 96328)

DCA KOREA - 1 (Chief, DCA-Korea Field Office
APO San Francisco 96301

DCA-Okinawa - 1 (Chief, DCA-Okinawa Field Office
FPO Seattle 98773)

DCA-Guam - 1 (Chief, DCA-Guam Field Office
Box 141, NAVCAMS WESTPAC
FPO San Francisco 96630

US NAV Shore EE PAC - 1 (U.S. Naval Short Electronic Engineering
Activity Pacific, Box 130, ATTN: Code 420
Pearl Harbor, HI 96860

1843 EE SQ - 1 (1843 EE Squadron, ATTN: EIEXM
Hickam AFB, HI 96853)

DCA FO ITALY - 1 (DCA Field Office Italy, Box 166
AFSOUTH (NATO), FPO New York 90524)

USDCFO - (Chief, USDCFO/US NATO
APO New York 90667)